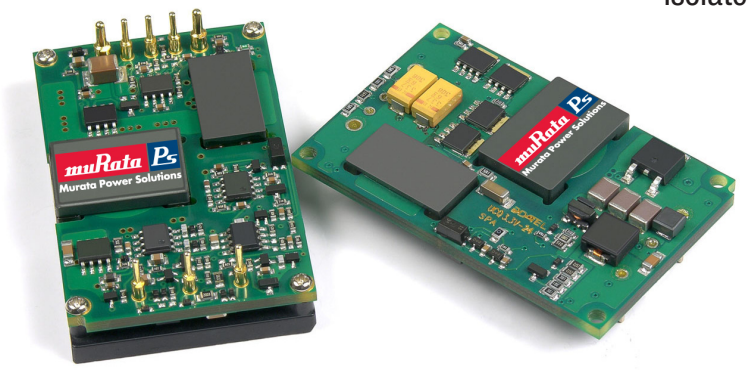
Single Output UCQ Models

Low-Profile, Quarter Brick, 8.3-40 Amp Isolated DC/DC Converters



Typical units

FEATURES

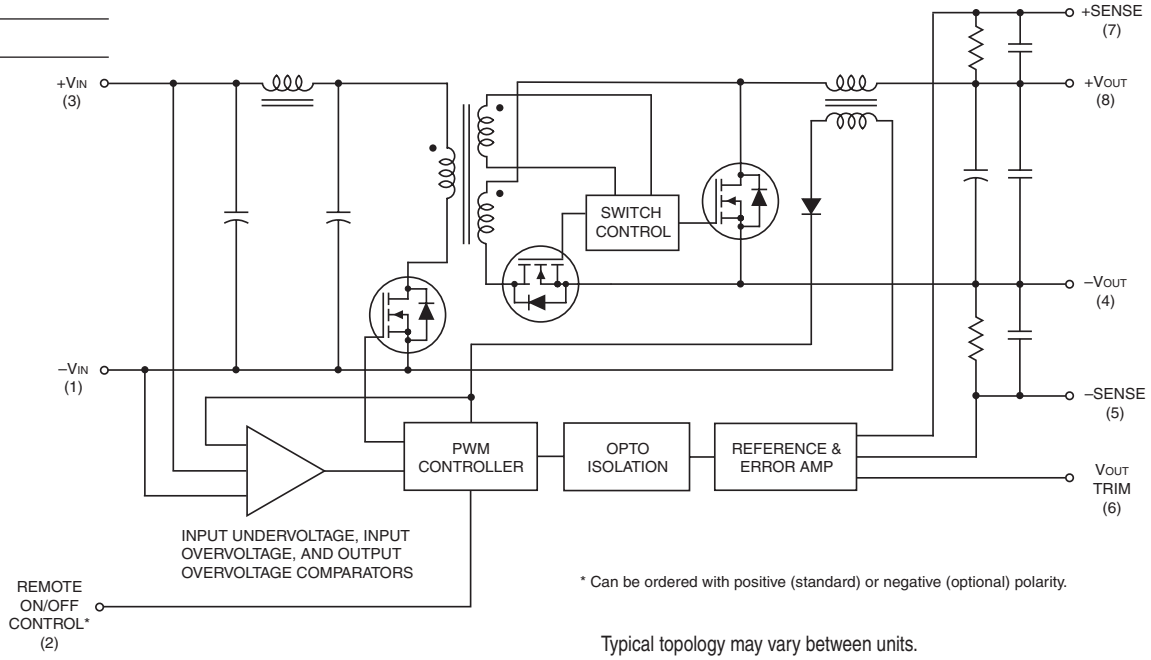
- Standard quarter-brick package/pinout
- Low cost; Low profile, 0.4" (10.2mm)
- 24V or 48V nominal input
- Outputs: 1.2V to 12V
- Interleaved synchronous-rectifier topology
  - Ultra high efficiency
  - No output reverse conduction
- Outstanding thermal performance
- On/off control, trim & sense functions
- Fully isolated, 2250Vdc (BASIC)
- Output overvoltage protection
- Fully I/O protected; Thermal shutdown
- Designed to meet UL/EN/IEC60950-1 safety approvals
- Qual/HALT/EMI tested

PRODUCT OVERVIEW

For applications requiring improved electrical and thermal performance at reduced cost, consider DATEL's new UCQ series "quarter brick" DC/DC power converters. These compact units measure just 1.45" x 2.3" x 0.4" (36.8 x 60.9 x 10.2 mm) and fit the industry-standard footprint.

Available outputs range between 1.2V @ 30 Amps to 12V @ 8.3 Amps and accept a wide input range. The UCQ's interleaved, synchronous-rectifier topology offers high efficiency (up to 93%), tight line and load regulation, low noise and fast step response. A single-board optimized open-frame design contributes to impressive thermal operation. UCQ's will operate up to +70°C and 100 LFM airflow with no derating.

The UCQ's feature full isolation to 2250Vdc meeting BASIC insulation requirements of UL/EN/IEC 60950-1. Input filters reduce propagated switching noise back to input sources. Also included is a remote On/Off switch control (with positive or negative polarity), output trim adjustable over nominal and output sense functions to reduce power lead losses. Extensive protection items avoid damage from out of limit voltages, currents and temperatures. Protection faults automatically recover using the hiccup technique. Besides safety testing to 60950-1, certifications for the UCQ include application for EMC compliance (to FCC class B), qualification testing (including HALT) and CE marking.



Typical topology may vary between units.

Figure 1. Simplified Schematic

RoHS COMPLIANT 2002/95/EC

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For full details go to www.murata-ps.com/rohs

Performance Specifications and Ordering Guide ①

ORDERING GUIDE

Root Models ①	Output							Input				Efficiency	
	V_{OUT} (Volts)	I_{OUT} (Amps)	Power (Watts)	R/N (mVp-p)		Regulation (Max.) ②		V_{IN} Nom. (Volts)	Range (Volts)	I_{IN} no load (mA)	I_{IN} full load (Amps)		
				Typ.	Max.	Line	Load					Min.	Typ.
UCQ-1.2/40-D24P-C	1.2	40	48	Please contact Murata Power Solutions for further information.									
UCQ-1.2/30-D48N-C	1.2	30	36	50	100	±0.125%	±0.25%	48	36-75	30	0.90	81%	83%
UCQ-1.5/25-D48N-C	1.5	25	37.5	50	80	±0.125%	±0.25%	48	36-75	50	0.94	81%	83%
UCQ-1.5/40-D48N-C	1.5	40	60	50	100	±0.125%	±0.25%	48	36-75	50	1.45	85%	86%
UCQ-1.8/30-D48N-C	1.8	30	54	100	TBD	±0.125%	±0.25%	48	36-75	45	1.31	83%	86%
UCQ-2.5/40-D24P-C	2.5	40	100	80	120	±0.125%	±0.25%	24	18-36	120	4.96	82%	84%
UCQ-2.5/30-D48N-C	2.5	30	75	50	100	±0.2%	±0.25%	48	36-75	50	1.80	85%	87%
UCQ-3.3/35-D24P-C	3.3	35	115.5	30	50	±0.125%	±0.25%	24	18-36	130	5.41	87%	89%
UCQ-3.3/20-D48N-C	3.3	20	66	50	80	±0.125%	±0.25%	48	36-75	50	1.53	88.5%	90%
UCQ-3.3/30-D48N-C	3.3	30	99	50	80	±0.2%	±0.25%	48	36-75	50	2.3	90%	91%
UCQ-5/20-D24P-C	5	20	100	50	60	±0.125%	±0.25%	24	18-36	160	4.55	88%	91.5%
UCQ-5/20-D48N-C	5	20	100	35	55	±0.125%	±0.25%	48	36-75	80	2.24	89%	93%
UCQ-5/25-D48N-C	5	25	125	Please contact Murata Power Solutions for further information.									
UCQ-8/12-D24P-C	8	12	96										
UCQ-12/8.3-D48N-C	12	8.3	99.6	100	150	±0.2%	±0.25%	48	36-75	80	2.28	90%	91%
UCQ-15/6.7-D24P-C	15	6.7	100.5	Please contact Murata Power Solutions for further information.									

① Please refer to the part number structure for additional ordering part numbers and options.
② All specifications are at nominal line voltage and full load, +25 deg.C unless otherwise noted. See detailed specifications. Output capacitors are 1 µF ceramic || 10 µF electrolytic. I/O caps are necessary for our test equipment and may not be needed for your application.

Outline dimensions: 2.3 × 1.45 × 0.39 inches
58.4 × 36.8 × 9.9 mm
Pinout: P32 (all models)

Single Output UCQ Models

Low-Profile, Quarter Brick, 8.3-40 Amp
Isolated DC/DC Converters

PART NUMBER STRUCTURE

U CQ - 3.3 / 35 - D48 N B H - C

Output Configuration:
Unipolar, single output

Quarter-Brick Package

Nominal Output Voltage

Maximum Rated Output :
Current in Amps

Input Voltage Range:
D24 = 18-36 Volts (24V nominal)
D48 = 36-75 Volts (48V nominal)

On/Off Control Polarity
P = Positive polarity (standard for D24, optional for D48)
N = Negative polarity (standard for D48, optional for D24)

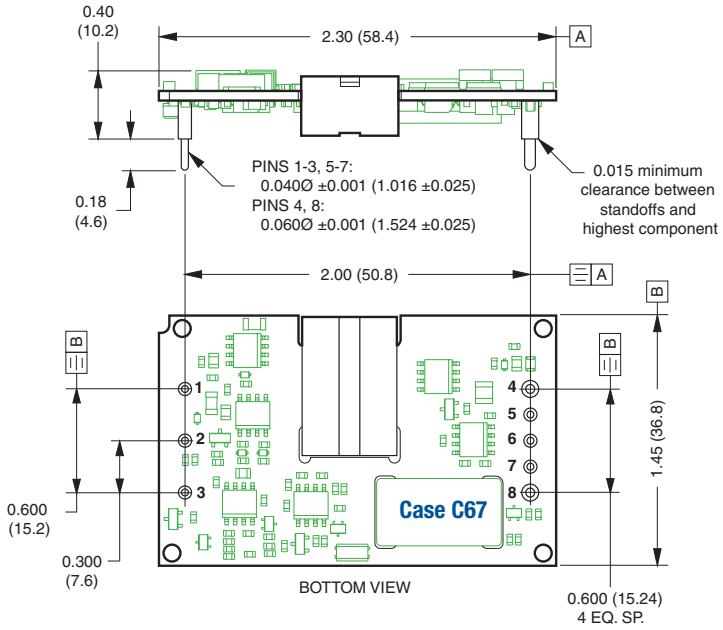
Baseplate (optional)
Blank = No baseplate, standard
B = Baseplate installed, optional special order

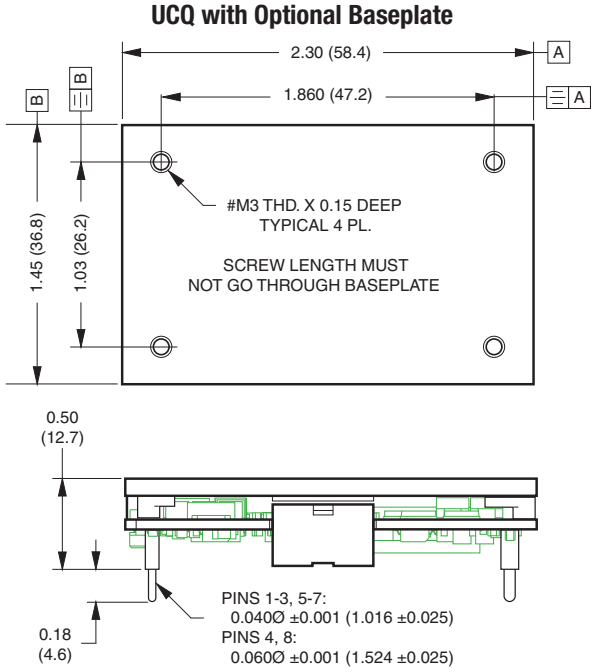
Conformal coating (optional)
Blank = no coating, standard
H = coating added, optional special order

RoHS Hazardous Materials compliance
C = RoHS-6 (no lead), standard
Y = RoHS-5 (with lead), optional, special order

Note: Some model combinations may not be available. Contact Murata Power Solutions for availability.

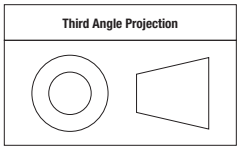
MECHANICAL SPECIFICATIONS





Dimensions are in inches (mm shown for ref. only).

Component locations may vary between units.



Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

I/O Connections			
Pin	Function P32	Pin	Function P32
1	–Input	5	–Sense
2	Remote On/Off	6	Output Trim
3	+Input	7	+Sense
4	–Output	8	+Output

Performance Specifications and Ordering Guide ①

	UCQ-1.2/30-D48	UCQ-1.5/25-D48	UCQ-1.5/40-D48	UCQ-1.8/30-D48	UCQ-2.5/40-D24	UCQ-2.5/30-D48	UCQ-3.3/35-D24
Input							
Input voltage range	See ordering guide.						
Start-up threshold, Volts	34	34	34	34	16.8	34	17
Undervoltage shutdown, V	33	32	32.5	32.5	15	32	15
Overvoltage shutdown	none						
Reflected (back) ripple current, mA pk-pk	10-30, model dependent						
Input Current							
Full load conditions	See ordering guide.						
Inrush transient, A^2sec	0.05						
Output short circuit, mA	50-200, model dependent						
No load, mA	30-160, model dependent						
Low line (V_{IN} = min.), Amps	1.23	1.26	1.96	1.74	6.69	2.39	7.21
Standby mode, mA (Off, UV, OT shutdown)	1-10, model dependent						
Internal input filter type	Pi-type	L-C	Pi-type	Pi-type	L-C	L-C	L-C
Reverse polarity protection	See notes.						
Remote On/Off Control							
Positive logic (P model suffix)	OFF = Ground pin to +0.8V ON = Open or +3.5 to +13.5V max						
Negative logic (N model suffix)	OFF = Open or +3.5 to +13.5V ON = Ground pin to +1V max						
Current, mA	1						
Output							
Voltage output range	See ordering guide.						
Voltage output accuracy	±1% of $V_{NOM.}$, (50% load)						
Adjustment range, % of $V_{NOM.}$	±10%	–20 + 10	±10%	±10%	–20 + 10	–20 + 10	±10%
Temperature coefficient	±0.02% of V_{OUT} range per °C						
Minimum loading	No minimum loading.						
Remote sense compensation	+10%						
Ripple/noise (20 MHz bandwidth)	See ordering guide.						
Line/Load regulation	See ordering guide.						
Efficiency	See ordering guide.						
Maximum capacitive loading, µF low ESR <0.02Ω max., resistive load	1,000	10,000 max.	10,000	4,700	10,000	10,000 max.	10,000

① Specs are typical unless noted.

Performance Specifications and Ordering Guide ①

	UCQ-3.3/20-D48	UCQ-3.3/30-D48	UCQ-5/20-D24	UCQ-5/20-D48	UCQ-12/8.3-D48
Input					
Input voltage range	See ordering guide				
Start-up threshold, Volts	35	35	17	35	35
Undervoltage shutdown, V	34	34	16	34	34
Overvoltage shutdown	none				
Reflected (back) ripple current, mA pk-pk	10-30, model dependent.				
Input Current					
Full load conditions	See ordering guide.				
Inrush transient, A^2sec	0.05				
Output short circuit, mA	50-200, model dependent				
No load, mA	30-160, model dependent				
Low line (V_{IN} = min.), Amps	2.04	3.05	6.04	3.02	3.04
Standby mode, mA (Off, UV, OT shutdown)	1-10, model dependent				
Internal input filter type	L-C	L-C	L-C	L-C	L-C
Reverse polarity protection	See notes.				
Remote On/Off Control					
Positive logic (P model suffix)	OFF = Ground pin to +0.8V ON = Open or +3.5 to +13.5V max				
Negative logic (N model suffix)	OFF = Open or +3.5 to +13.5V ON = Ground pin to +1V max				
Current, mA	1				
Output					
Voltage output range	See ordering guide.				
Voltage output accuracy	±1% of $V_{NOM.}$, (50% load)				
Adjustment range, % of $V_{NOM.}$	–10 to + 10%				
Temperature coefficient	±0.02% of V_{OUT} range per °C.				
Minimum loading	No minimum loading.				
Remote sense compensation	+10%				
Ripple/noise (20 MHz bandwidth)	See ordering guide.				
Line/Load regulation	See ordering guide.				
Efficiency	See ordering guide.				
Maximum capacitive loading, µF low ESR <0.02Ω max., resistive load	10,000	10,000	10,000	10,000	10,000

① Specs are typical unless noted.

Performance Specifications and Ordering Guide ①

	UCQ-1.2/30-D48	UCQ-1.5/25-D48	UCQ-1.5/40-D48	UCQ-1.8/30-D48	UCQ-2.5/40-D24	UCQ-2.5/30-D48	UCQ-3.3/35-D24
Isolation Voltage							
Input to Output, Volts min.	2250						
Input to baseplate, Volts min.	1500						
Baseplate to output, Volts min.	1500						
Isolation resistance, MΩ	10-100, model dependent						
Isolation capacitance, pF	1000						
Isolation safety rating	Basic insulation						
Miscellaneous							
Current limit inception (98% of VOUT, after warmup), Amps	35	35	49	36	46	37	45
Short circuit protection method	Current limiting, hiccup autorestart. Remove overload for recovery.						
Short circuit current, Amps	5						
Short circuit duration	Continuous, output shorted to ground. No damage.						
Overvoltage protection, Volts (via magnetic feedback)	1.8	1.8	1.95	2.7 V max	2.95	2.95	4
Dynamic characteristics							
Dynamic load response (50-75-50% load step)	200 µSec to ±1% of final value	200 µSec to ±1% of final value	50 µSec to ±1% of final value	100 µSec to ±1% of final value	200 µSec to ±1% of final value	200 µSec to ±1% of final value	100 µSec to ±1% of final value
Start-up time							
VIN to VOUT regulated, mSec	50	50	50	50	50	50	2
Remote On/Off to VOUT regulated, mSec	50	50	50	50	50	50	3
Switching frequency, KHz	350 ± 20	440 ± 40	400 ± 40	400	480	450 ± 30	350 ± 10
Environmental							
Calculated MTBF	TBD		2.2M hours	TBD			
Operating temperature range See Derating curves.	–40 to +85, with derating						
Operating case temperature, °C" (no derating)	–40 to +110		–40 to +120	–40 to +110			
Storage temperature range, °C	–55 to +125						
Thermal protection/ shutdown, °C	110-125, model dependent						
Relative humidity	To +85°C/85%, non-condensing						

① Specs are typical unless noted.

Performance Specifications and Ordering Guide ①

	UCQ-3.3/20-D48	UCQ-3.3/30-D48	UCQ-5/20-D24	UCQ-5/20-D48	UCQ-12/8.3-D48
Isolation Voltage					
Input to Output, Volts min.	2250				
Input to baseplate, Volts min.	1500				
Baseplate to output, Volts min.	1500				
Isolation resistance, MΩ	10-100, model dependent				
Isolation capacitance, pF	1000				
Isolation safety rating	Basic insulation				
Current limit inception (98% of V_{OUT}, after warmup), Amps	24 min.	33 min.	26	22 min.	10
Short circuit protection method	Current limiting, hiccup autorestart. Remove overload for recovery.				
Short circuit current, Amps	5				
Short circuit duration	Continuous, output shorted to ground. No damage.				
Overvoltage protection, Volts (via magnetic feedback)	4.6 max.	4 max.	6.25	TBD	14.4
Dynamic characteristics					
Dynamic load response (50-75-50% load step)	200 µSec to ±1% of final value	200 µSec to ±1% of final value	200 µSec to ±1% of final value	200 µSec to ±1% of final value	200 µSec to ±1% of final value
Start-up time					
V_{IN} to V_{OUT} regulated, mSec	50	50 max.	4	10 max.	50
Remote On/Off to V_{OUT} regulated, mSec	50	50 max.	4	10 max.	50
Switching frequency, KHz	330 ± 40	330 ± 40	400 ± 24	315 ± 30	330 ± 40
Environmental					
Calculated MTBF	TBD				
Operating temperature range See Derating curves.	–40 to +85, with derating				
Operating case temperature, °C" (no derating)	–40 to +110				
Storage temperature range, °C	–55 to +125				
Thermal protection/ shutdown, °C	110-125, model dependent				
Relative humidity	To +85°C/85%, non-condensing				

① Specs are typical unless noted.

Performance Specifications and Ordering Guide ①

	UCQ-1.2/30-D48	UCQ-1.5/25-D48	UCQ-1.5/40-D48	UCQ-1.8/30-D48	UCQ-2.5/40-D24	UCQ-2.5/30-D48	UCQ-3.3/35-D24
Physical							
Outline dimensions	See mechanical specs.						
Pin material	Copper alloy						
Pin diameter	0.04/0.062 inches (1.016/1.524 mm)						
Pin finish	Nickel underplate with gold overplate						
Weight, ounces	1.06	1.06	0.9	0.9	1.06	1.06	1.02
Weight, grams	30	30	25	25	30	30	29
Electromagnetic interference	FCC part 15, class B, EN55022 (Conducted and radiated. External filter required)						
Safety	UL 60950-1, CSA C22.2 No.60950-1, IEC/EN 60950-1						

	UCQ-3.3/20-D48	UCQ-3.3/30-D48	UCQ-5/20-D24	UCQ-5/20-D48	UCQ-12/8.3-D48
Physical					
Outline dimensions	See mechanical specs.				
Pin material	Copper alloy				
Pin diameter	0.04/0.062 inches (1.016/1.524 mm)				
Pin finish	Nickel underplate with gold overplate				
Weight, ounces	0.7	TBD	1.06	TBD	1.13
Weight, grams	20	TBD	30	TBD	32
Electromagnetic interference	FCC part 15, class B, EN55022 (Conducted and radiated. External filter required)				
Safety	UL 60950-1, CSA C22.2 No.60950-1, IEC/EN 60950-1				

Caution: This product is not internally fused. To comply with safety agency certifications and to avoid injury to personnel or equipment, the user must supply an external fast-blow fuse to the input terminals. See fuse information.

Specification Notes

(1) All models are tested and specified with external 1||10 µF ceramic/tantalum output capacitors no external input capacitor. All capacitors are low ESR types. These capacitors are necessary to accommodate our test equipment and may not be required to achieve specified performance in your applications. All models are stable and regulate within spec under no-load conditions. All specifications are typical unless noted. General conditions for Specifications are +25 deg.C, V_{IN} and V_{OUT} = nominal, full load. Adequate airflow must be supplied for extended testing under power.
(2) Input Ripple Current is tested and specified over a 5 Hz to 20 MHz bandwidth. Input filtering is C_{IN} = 33 µF, 100V tantalum, C_{BUS} = 220 µF, 100V electrolytic, L_{BUS} = 12 µH.
(3) Note that Maximum Power Derating curves indicate an average current at nominal input voltage. At higher temperatures and/or lower airflow, the DC/DC converter will tolerate brief full current outputs if the total RMS current over time does not exceed the Derating curve. All Derating curves are presented at sea level altitude. Be aware of reduced power dissipation with increasing density altitude.
(4) Mean Time Before Failure is calculated using the Telcordia (Belcore) SR-332 Method 1, Case 3, ground fixed conditions, Tpcboard = +25 deg.C, full output load, natural air convection.
(5) The On/Off Control is normally controlled by a switch or open collector or open drain transistor. But it may also be driven with external logic or by applying appropriate external voltages which are referenced to Input Common.
(6) Short circuit shutdown begins when the output voltage degrades approximately 2% from the selected setting.
(7) The outputs are not intended to sink appreciable reverse current. This may damage the outputs.
(8) Output noise may be further reduced by adding an external filter. See I/O Filtering and Noise Reduction.
(9) All models are fully operational and meet published specifications, including "cold start" at –40 C.
(10) Regulation specifications describe the deviation as the line input voltage or output load current is varied from a nominal midpoint value to either extreme.
(11) Output accuracy is dependent on user-supplied trim resistors. To achieve high accuracy, use ±1% or better tolerance metal-film resistors mounted close to the converter.
(12) Output current limit and short circuit protection is non-latching. When the overcurrent fault is removed, the converter will immediately recover.
(13) Do not exceed maximum power specifications when adjusting the output trim.
(14) At zero output current, the output may contain low frequency components which exceed the ripple specification. The output may be operated indefinitely with no load.
(15) Input Fusing: If reverse polarity is accidentally applied to the input, a body diode will become forward biased and will conduct considerable current. To ensure reverse input protection with full output load, always connect an external input fast-blow fuse in series with the $+V_{IN}$ input. Use approximately twice the full input current rating with nominal input voltage.
(16) "Hiccup" overcurrent operation repeatedly attempts to restart the converter with a brief, full-current output. If the overcurrent condition still exists, the restart current will be removed and then tried again. This short current pulse prevents overheating and damaging the converter. Once the fault is removed, the converter immediately recovers normal operation.

Absolute Maximum Ratings		
Input Voltage	**24V Models**	**48V Models**
Continuous	0 to +36 Volts	0 to +75 Volts
Transient (100msec)	+50 Volts	+100 Volts
On/Off Control	0V min. to +13.5V max.	
Input Reverse Polarity Protection	See Fuse section	
Output Overvoltage	TBD	
Output Current	Current-limited. Devices can withstand sustained short circuit without damage.	
Operating Temperature	–40 to +100°C	
Storage Temperature	–55 to +125°C	
Lead Temperature (soldering 10 sec. max.)	+280°C	

These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied, nor recommended.

Input Fusing

Certain applications and/or safety agencies may require the installation of fuses at the inputs of power conversion components. Fuses should also be used if the possibility of sustained, non-current-limited, input-voltage polarity reversals exists. For DATEL UCQ series DC/DC converters, we recommend the use of a time delay fuse, installed in the ungrounded input supply line.

As a rule of thumb however, we recommend the use of a normal-blow or slow-blow fuse with a typical value about twice the maximum input current, calculated at low line with the converter's minimum efficiency.

All relevant national and international safety standards and regulations must be observed by the installer. For system safety agency approvals, the converters must be installed in compliance with the requirements of the end- use safety standard, i.e. IEC/EN/UL60950-1.

Input Reverse-Polarity Protection

If the input voltage polarity is accidentally reversed, an internal diode will become forward biased and likely draw excessive current from the power source. If this source is not current limited or the circuit appropriately fused, it could cause permanent damage to the converter.

Input Under-Voltage Shutdown and Start-Up Threshold

Under normal start-up conditions, devices will not begin to regulate properly until the ramping-up input voltage exceeds the Start-Up Threshold Voltage. Once operating, devices will not turn off until the input voltage drops below the Under-Voltage Shutdown limit. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.

Start-Up Time

The V_{IN} to V_{OUT} Start-Up Time is the time interval between the point at which the ramping input voltage crosses the Start-Up Threshold and the fully loaded output voltage enters and remains within its specified accuracy band. Actual measured times will vary with input source impedance, external input capacitance, and the slew rate and final value of the input voltage as it appears at the converter. The UCQ Series implements a soft start circuit to limit the duty cycle of its PWM controller at power up, thereby limiting the input inrush current.

The On/Off Control to V_{OUT} start-up time assumes the converter has its nominal input voltage applied but is turned off via the On/Off Control pin. The specification defines the interval between the point at which the converter is turned on (released) and the fully loaded output voltage enters and remains within its specified accuracy band. Similar to the V_{IN} to V_{OUT} start-up, the On/Off Control to V_{OUT} start-up time is also governed by the internal soft start circuitry and external load capacitance. The difference in start up time from V_{IN} to V_{OUT} and from On/Off Control to V_{OUT} is therefore insignificant.

Input Source Impedance

The input of UCQ converters must be driven from a low ac-impedance source. The DC/DC's performance and stability can be compromised by the use of highly inductive source impedances. The input circuit shown in Figure 2 is a practical solution that can be used to minimize the effects of inductance in the input traces. For optimum performance, components should be mounted close to the DC/DC converter.

I/O Filtering, Input Ripple Current, and Output Noise

All models in the UCQ Series are tested/specified for input reflected ripple current and output noise using the specified external input/output components/circuits and layout as shown in the following two figures. External input capacitors (C_{IN} in Figure 2) serve primarily as energy-storage elements, minimizing line voltage variations caused by transient IR drops in conductors from backplane to the DC/DC. Input caps should be selected for bulk capacitance (at appropriate frequencies), low ESR, and high rms-ripple-current ratings. The switching nature of DC/DC converters requires that dc voltage sources have low ac impedance as highly inductive source impedance can affect system stability. In Figure 2, C_{BUS} and L_{BUS} simulate a typical dc voltage bus. Your specific system configuration may necessitate additional considerations.

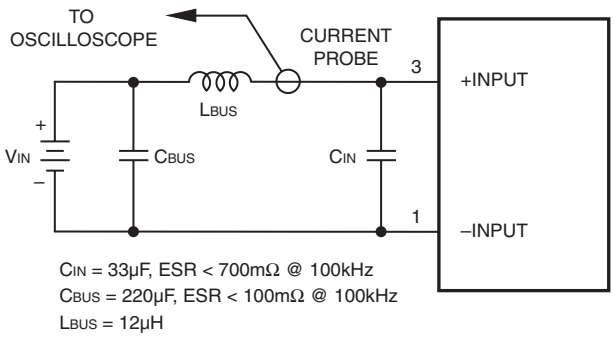
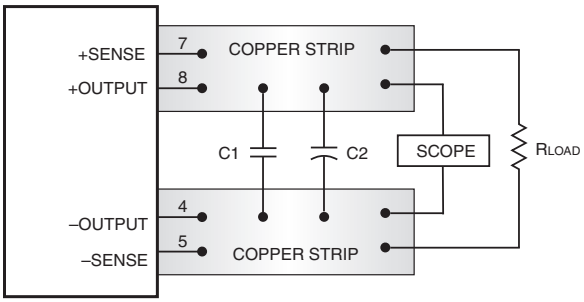


Figure 2. Measuring Input Ripple Current

In critical applications, output ripple/noise (also referred to as periodic and random deviations or PARD) may be reduced below specified limits using filtering techniques, the simplest of which is the installation of additional external output capacitors. They function as true filter elements and should be selected for bulk capacitance, low ESR and appropriate frequency response.

All external capacitors should have appropriate voltage ratings and be located as close to the converter as possible. Temperature variations for all relevant parameters should also be taken carefully into consideration. The most effective combination of external I/O capacitors will be a function of line voltage and source impedance, as well as particular load and layout conditions.

In Figure 3, the two copper strips simulate real-world PCB impedances between the power supply and its load. In order to minimize measurement errors, scope measurements should be made using BNC connectors, or the probe ground should be less than ½ inch and soldered directly to the fixture.



C1 = 1µF CERAMIC
C2 = 10µF TANTALUM
LOAD 2-3 INCHES (51-76mm) FROM MODULE

Figure 3. Measuring Output Ripple/Noise (PARD)

Floating Outputs

Since these are isolated DC/DC converters, their outputs are "floating" with respect to their input. Designers will normally use the –Output (pin 4) as the ground/return of the load circuit. You can however, use the +Output (pin 8) as ground/return to effectively reverse the output polarity.

Minimum Output Loading Requirements

UCQ converters employ a synchronous-rectifier design topology and all models regulate within spec and are stable under no-load to full load conditions. Operation under no-load conditions however might slightly increase the output ripple and noise.

Thermal Shutdown

The UCQ converters are equipped with thermal-shutdown circuitry. If environmental conditions cause the temperature of the DC/DC converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will self start. See Performance/Functional Specifications.

Output Over-Voltage Protection

The UCQ output voltage is monitored for an over-voltage condition using a comparator. The signal is optically coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltage to decrease. Following a time-out period the PWM will restart, causing the output voltage to ramp to its appropriate value. If the fault condition persists, and the output voltage again climbs to excessive levels, the over-voltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

Current Limiting

As soon as the output current increases to approximately 130% of its rated value, the DC/DC converter will go into a current-limiting mode. In this condition, the output voltage will decrease proportionately with increases in output current, thereby maintaining somewhat constant power dissipation. This is commonly referred to as power limiting. Current limit inception is defined as the point at which the full-power output voltage falls below the specified tolerance. See Performance/Functional Specifications. If the load current, being drawn from the converter, is significant enough, the unit will go into a short circuit condition as described below.

Short Circuit Condition

When a converter is in current-limit mode, the output voltage will drop as the output current demand increases. If the output voltage drops too low, the magnetically coupled voltage used to develop primary side voltages will also drop, thereby shutting down the PWM controller. Following a time-out period, the PWM will restart causing the output voltage to begin ramping to their appropriate value. If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The UCQ Series is capable of enduring an indefinite short circuit output condition.

Remote Sense

Note: The Sense and V_{OUT} lines are internally connected through low-value resistors. Nevertheless, if the sense function is not used for remote regulation the user should connect the +Sense to $+V_{OUT}$ and –Sense to $-V_{OUT}$ at the DC/DC converter pins. UCQ series converters employ a sense feature to provide point of use regulation, thereby overcoming moderate IR drops in PCB conductors or cabling. The remote sense lines carry very little current and therefore require minimal cross-sectional-area conductors. The sense lines, which are capacitively coupled to their respective output lines, are used by the feedback control-loop to regulate the output. As such, they are not low impedance points and must be treated with care in layouts and cabling. Sense lines on a PCB should be run adjacent to dc signals, preferably ground.

$$[V_{OUT}(+)\text{-}V_{OUT}(-)] - [\text{Sense}(+)\text{-Sense}(-)] \leq 10\%V_{OUT}$$

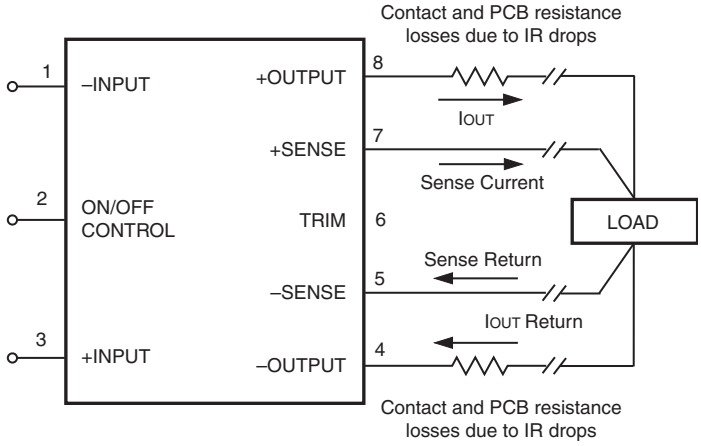


Figure 4. Remote Sense Circuit Configuration

In cables and discrete wiring applications, twisted pair or other techniques should be used. Output over-voltage protection is monitored at the output voltage pin, not the Sense pin. Therefore, excessive voltage differences between V_{OUT} and Sense in conjunction with trim adjustment of the output voltage can

cause the over-voltage protection circuitry to activate (see Performance Specifications for over-voltage limits). Power derating is based on maximum output current and voltage at the converter's output pins. Use of trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating, or cause output voltages to climb into the output over-voltage region. Therefore, the designer must ensure:

(V_{OUT} at pins) x (I_{OUT}) ≤ rated output power

Trimming Output Voltage

UCQ converters have a trim capability (pin 6) that enables users to adjust the output voltage (refer to the trim equations and trim graphs that follow). Adjustments to the output voltage can be accomplished via a trim pot (Figure 5) or a single fixed resistor as shown in Figures 6 and 7. A single fixed resistor can increase or decrease the output voltage depending on its connection. Resistors should be located close to the converter and have TCR's less than 100ppm/°C to minimize sensitivity to changes in temperature. If the trim function is not used, leave the trim pin open.

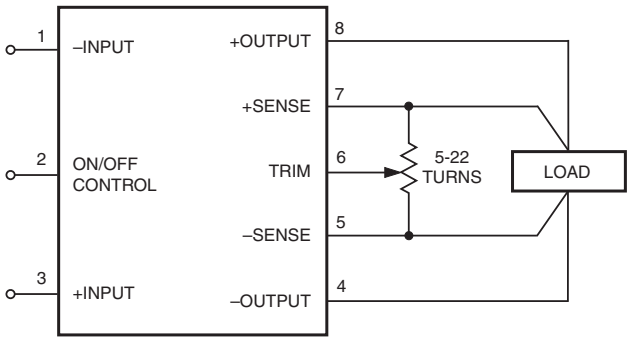


Figure 5. Trim Connections Using A Trimpot

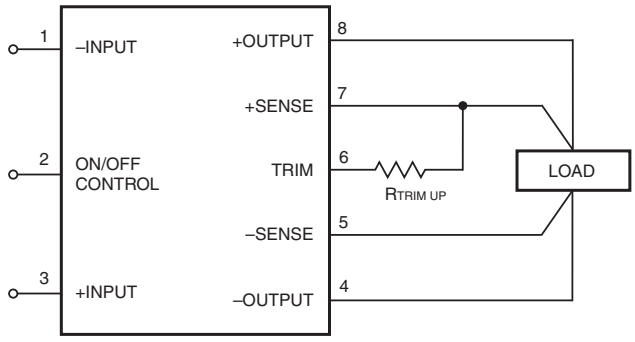


Figure 6. Trim Connections To Increase Output Voltages Using Fixed Resistors

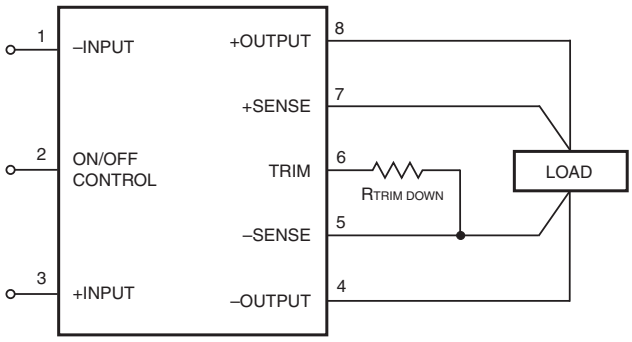


Figure 7. Trim Connections To Decrease Output Voltages Using Fixed Resistors

A single resistor connected from the Trim pin (pin 6) to the +Sense (pin 7) will increase the output voltage. A resistor connected from the Trim Pin (pin 6) to the –Sense (pin 5) will decrease the output voltage.

Trim Equations

(For all models **except** the UCQ-1.2/40-D24 and -1.2/30-D48)

Trim Down
Connect trim resistor between trim pin and –Sense

$$R_{TrimDn}\,(k\,\Omega) = \frac{5.11}{\Delta} - 10.22$$

Trim Up
Connect trim resistor between trim pin and +Sense

$$R_{TrimUp}\,(k\,\Omega) = \frac{5.11 \times V_{NOM} \times (1+\Delta)}{1.225 \times \Delta} - \frac{5.11}{\Delta} - 10.22$$

Where,

$\Delta = |\,(V_{NOM} - V_{OUT}) / V_{NOM}\,|$

V_{NOM} is the nominal, untrimmed output voltage.

V_{OUT} is the desired new output voltage.

Do not exceed the specified trim range or maximum power ratings when adjusting trim. Use 1% precision resistors mounted close to the converter on short leads.

(For the UCQ-1.2/40-D24 and -1.2/30-D48)

Trim Down
Connect trim resistor between trim pin and –Sense

$$R_{TrimDn}\,(k\,\Omega) = \frac{5.11}{2\Delta - 2}$$

Trim Up
Connect trim resistor between trim pin and +Sense

$$R_{TrimUp}\,(k\,\Omega) = \frac{5.11 \times V_{NOM} \times (1+\Delta)}{1.225 \times \Delta}$$

Trim adjustments greater than the specified range can have an adverse affect on the converter's performance and are not recommended. Excessive voltage differences between V_{OUT} and Sense, in conjunction with trim adjustment of the output voltage, can cause the over-voltage protection circuitry to activate (see Performance Specifications for over-voltage limits). Temperature/power derating is based on maximum output current and voltage at the converter's output pins. Use of the trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating, or cause output voltages to climb into the output over-voltage region. Therefore:

(V_{OUT} at pins) x (I_{OUT}) ≥ rated output power

The Trim pin (pin 6) is a relatively high impedance node that can be susceptible to noise pickup when connected to long conductors in noisy environments. In such cases, a 0.22µF capacitor between trim and –VOUT can be added to reduce this long lead effect.

On/Off Control

The input-side, remote On/Off Control function (pin 2) can be ordered to operate with either polarity:

Positive (no suffix)**:** standard models are equipped with Positive-polarity and are enabled when pin 2 is left open (or is pulled high, applying +3.5V to +13.5V with respect to –Input, pin 1) as per Figure 8. Positive-polarity devices are disabled when pin 2 is pulled low (0 to 0.8V with respect to –Input).

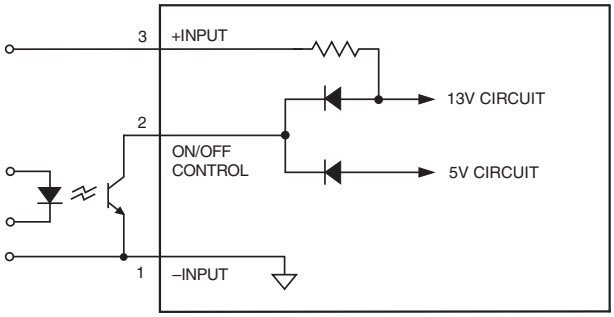


Figure 8. Driving the Negative Polarity On/Off Control Pin

Negative ("N" suffix): Optional Negative-polarity devices are off when pin 2 is left open (or pulled high, applying +3.5V to +13.5V), and on when pin 2 is pulled low (0 to 1V) with respect to –Input as shown in Figure 9.

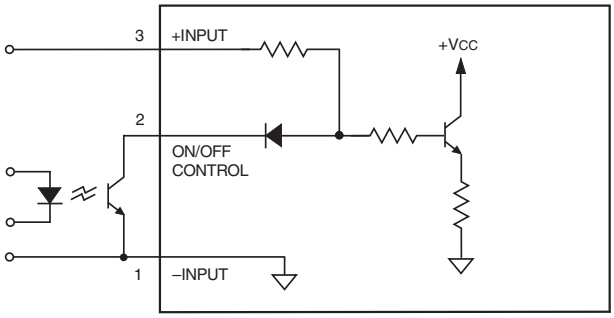
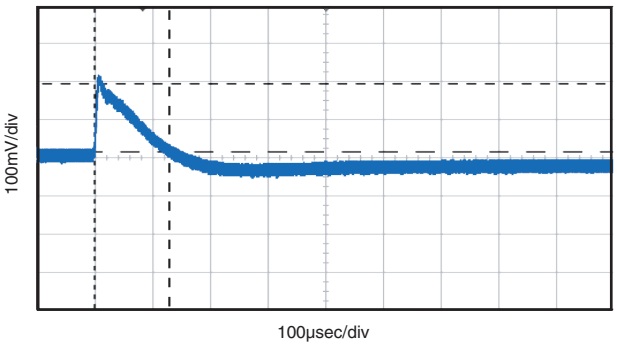


Figure 9. Driving the Negative Polarity On/Off Control Pin

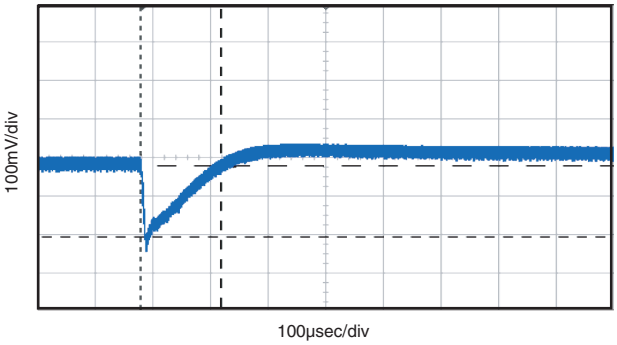
Dynamic control of the remote on/off function is best accomplished with a mechanical relay or an open-collector/open-drain drive circuit (optically isolated if appropriate). The drive circuit should be able to sink appropriate current (see Performance Specifications) when activated and withstand appropriate voltage when deactivated. Applying an external voltage to pin 2 when no input power is applied to the converter can cause permanent damage to the converter.

Typical Performance Curves

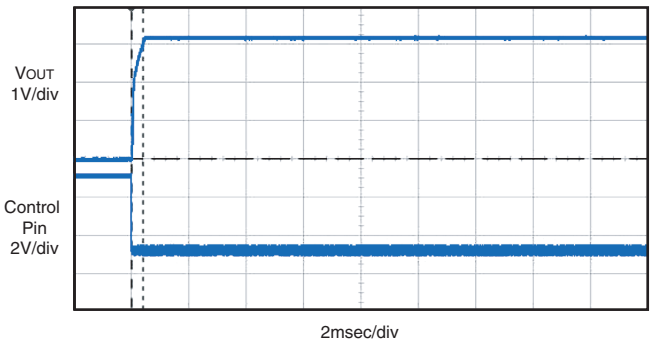
UCQ-3.3/30-D48 Output Transient Response
(VIN = 48V, resistive load step 75% to 50%)



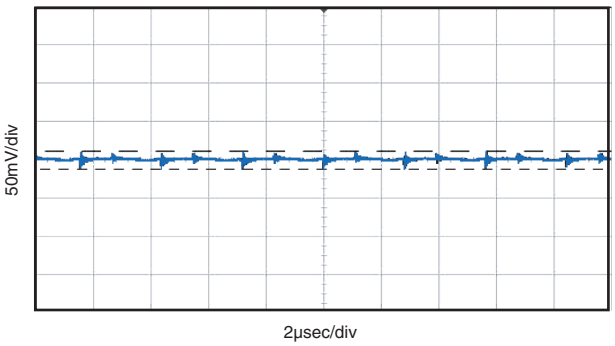
UCQ-3.3/30-D48 Output Transient Response
(VIN = 48V, resistive load step 50% to 75%)



UCQ-3.3/30-D48 Enable On/Off
(VIN = 48V, IOUT = 30A)

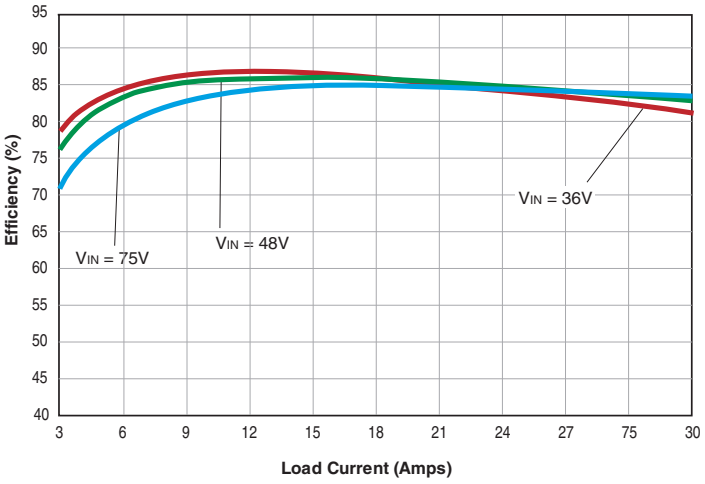


UCQ-3.3/30-D48 Ripple and Noise
(VIN = 48V, IOUT = 30A resistive, output caps 1µF ceramic || 10µF tantalum)

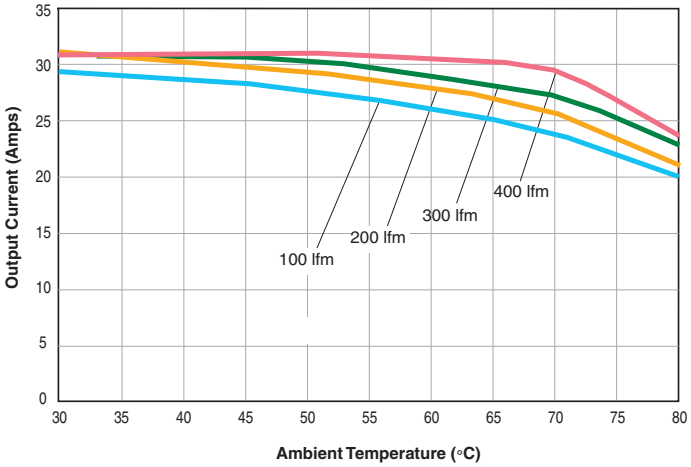


Typical Performance Curves

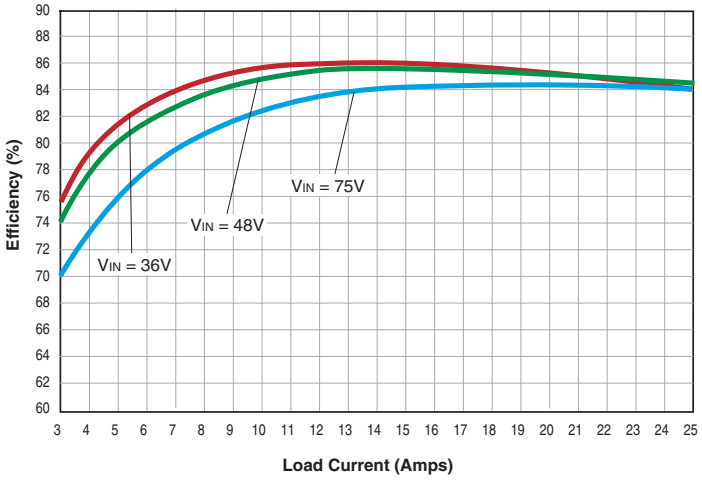
UCQ-1.2/30-D48 Efficiency vs Line Voltage and Load Current @25˚ C



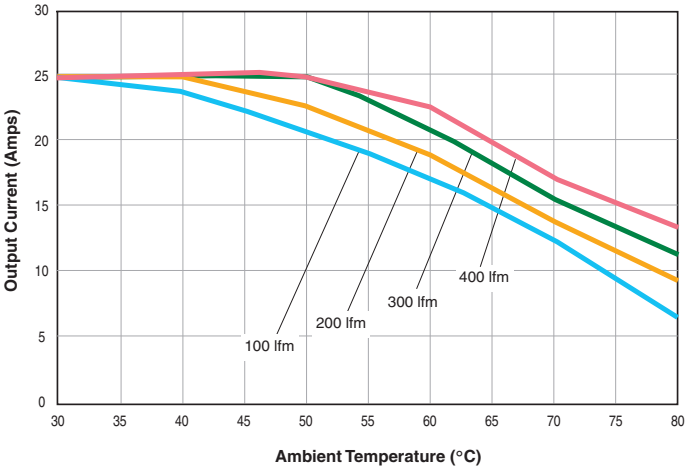
UCQ-1.2/30-D48 Maximum Current Temperature Derating
No baseplate, V_{IN} = 48V (at sea level), longitudinal airflow



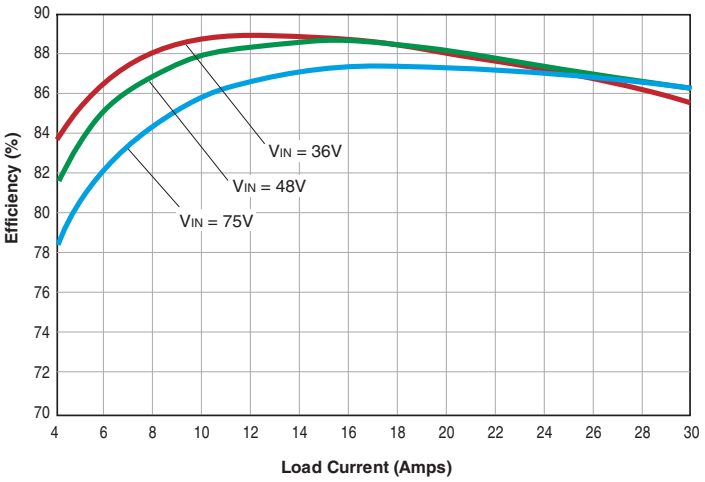
UCQ-1.5/25-D48 Efficiency vs Line Voltage and Load Current @25˚ C



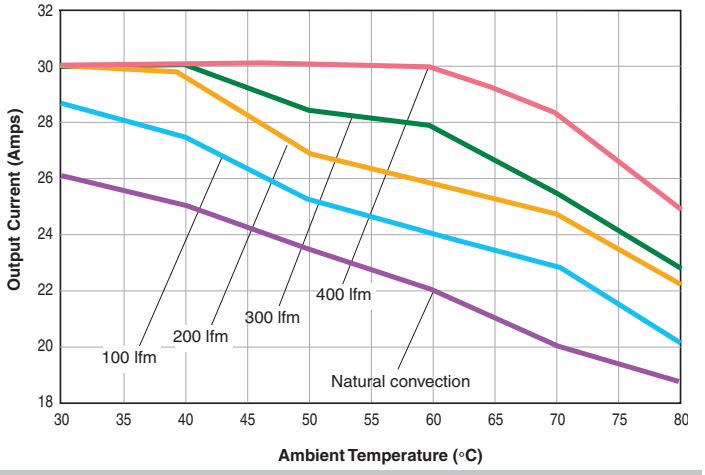
UCQ-1.5/25-D48 Maximum Current Temperature Derating
No baseplate, V_{IN} = 48V (at sea level), longitudinal airflow



UCQ-1.8/30-D48 Efficiency vs Line Voltage and Load Current @25˚ C

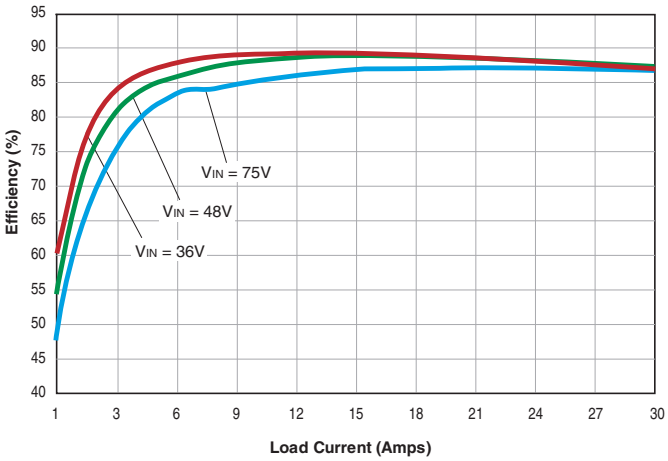


UCQ-1.8/30-D48 Maximum Current Temperature Derating
No baseplate, V_{IN} = 48V (at sea level), longitudinal airflow

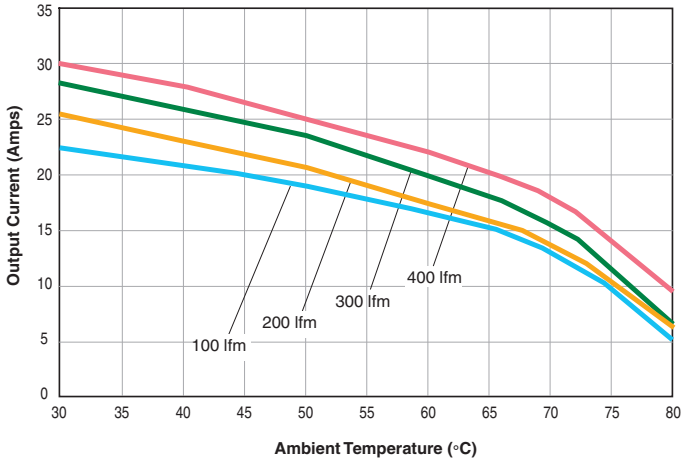


Typical Performance Curves

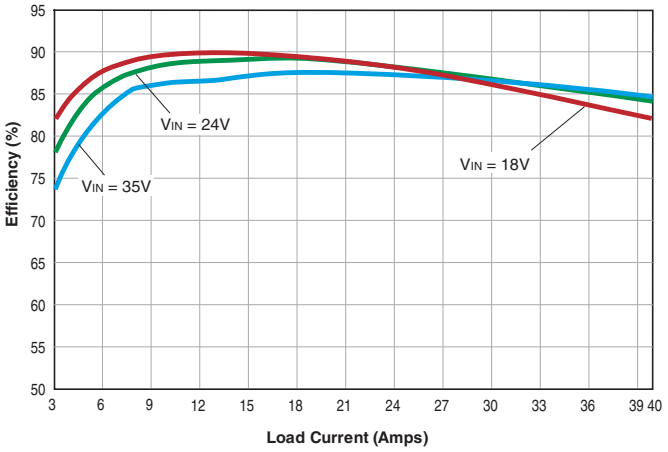
UCQ-2.5/30-D48 Efficiency vs Line Voltage and Load Current @25° C



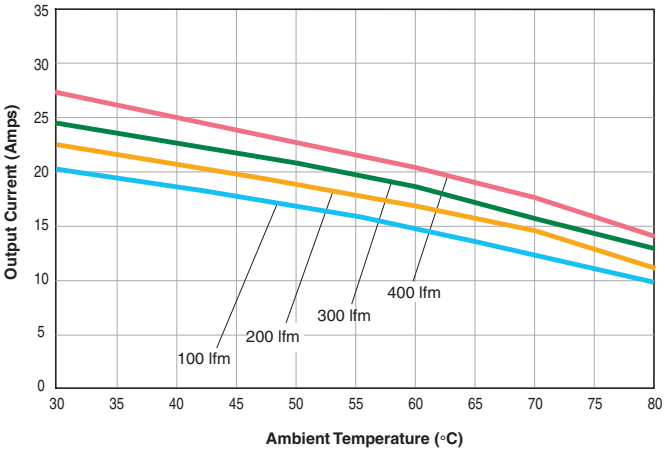
UCQ-2.5/30-D48 Maximum Current Temperature Derating
No baseplate, VIN = 24V (at sea level)



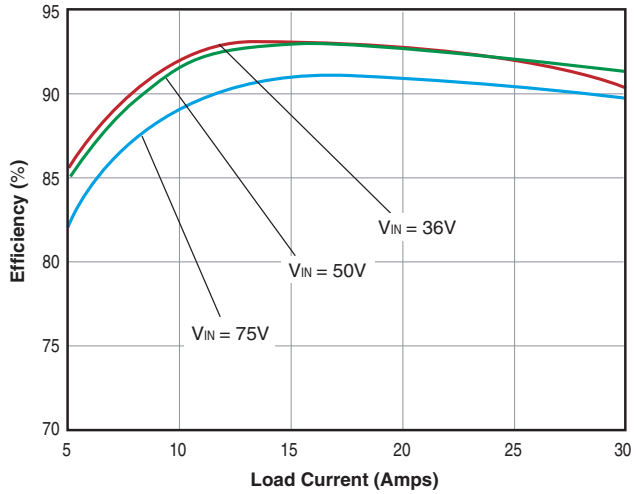
UCQ-2.5/40-D24 Efficiency vs Line Voltage and Load Current @25° C



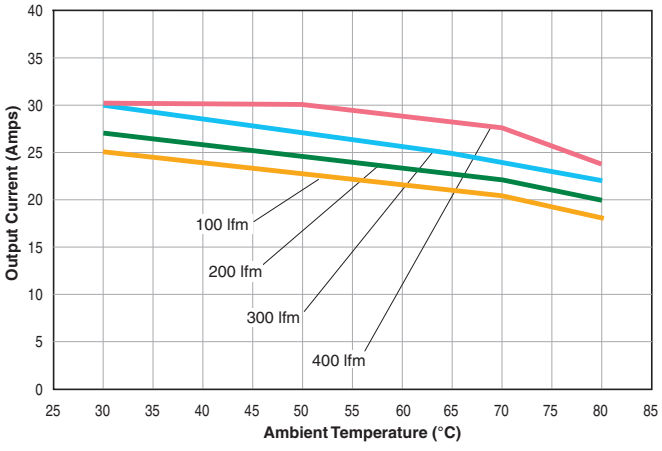
UCQ-2.5/40-D24 Maximum Current Temperature Derating
No baseplate, VIN = 24V (at sea level)



UCQ-3.3/30-D48 Efficiency vs Line Voltage and Load Current @25°C

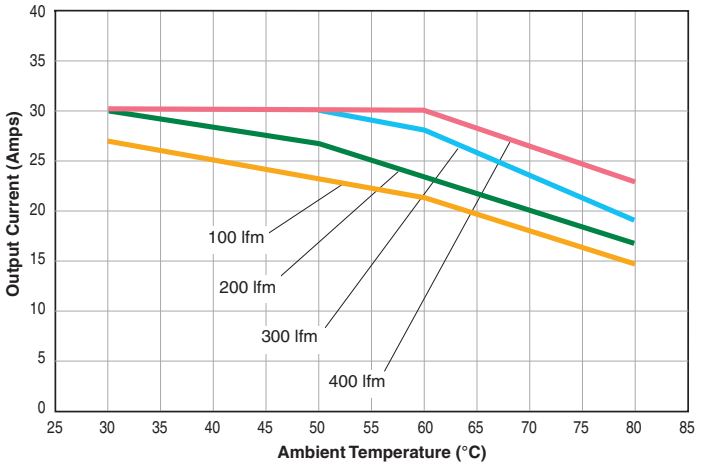


UCQ-3.3/30-D48 Maximum Current Temperature Derating
No baseplate, VIN = 48V (at sea level)

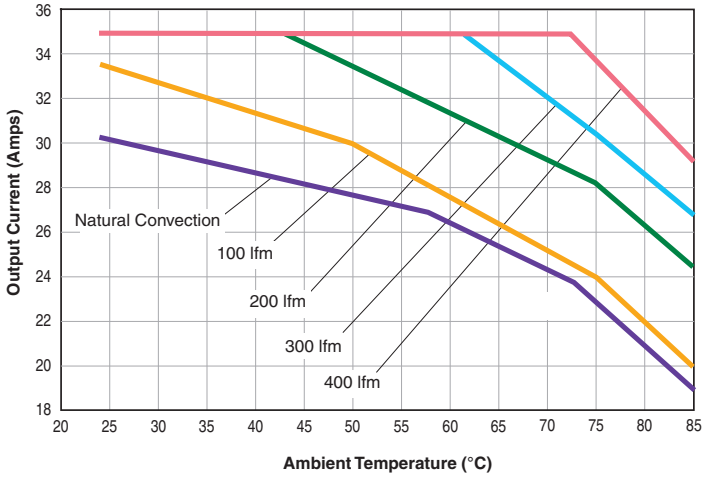


Typical Performance Curves

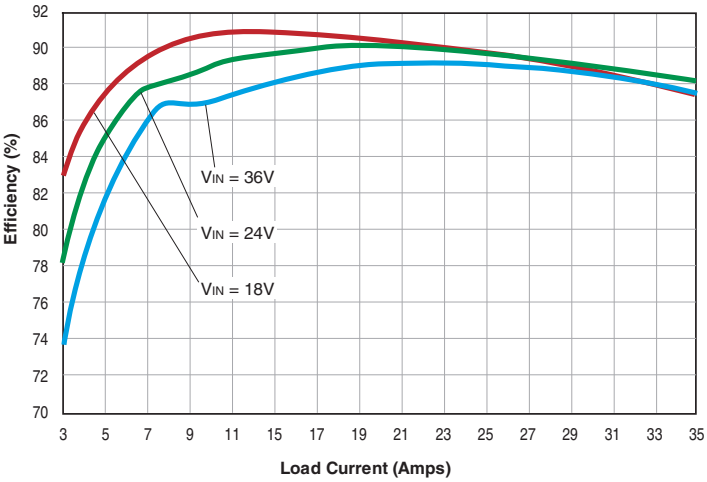
UCQ-3.3/30-D48 Maximum Current Temperature Derating
With baseplate, V_{IN} = 48V (at sea level)



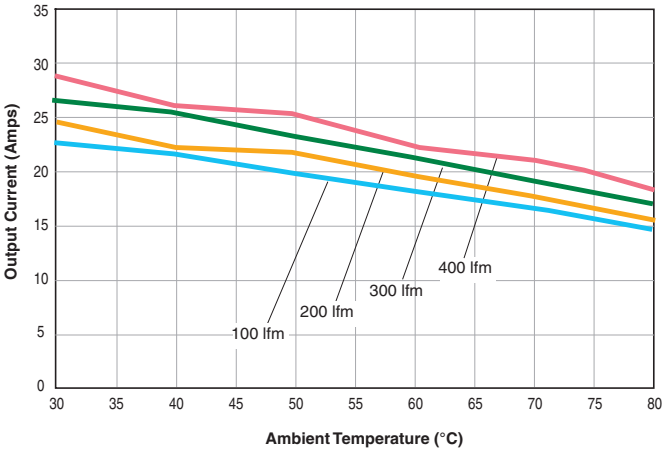
UCQ-3.3/35-D48 Maximum Current Temperature Derating
With baseplate, V_{IN} = 48V (transverse air flow at sea level)



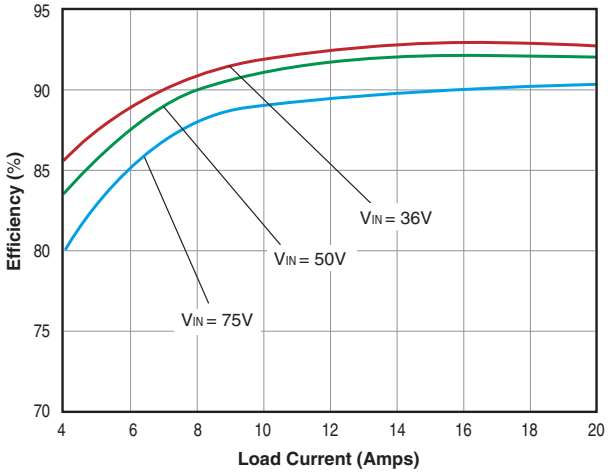
UCQ-3.3/35-D24 Efficiency vs Line Voltage and Load Current @25˚ C



UCQ-3.3/35-D24 Maximum Current Temperature Derating
No baseplate, V_{IN} = 48V (at sea level), longitudinal airflow

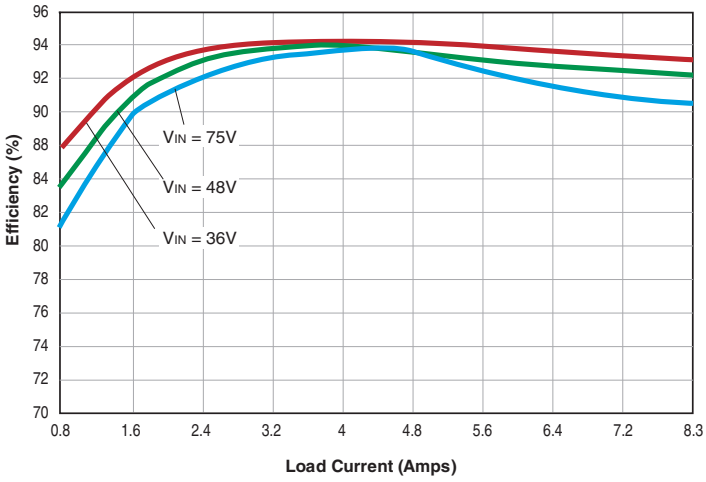


UCQ-5/20-D48
Efficiency vs Line Voltage and Load Current @25°C

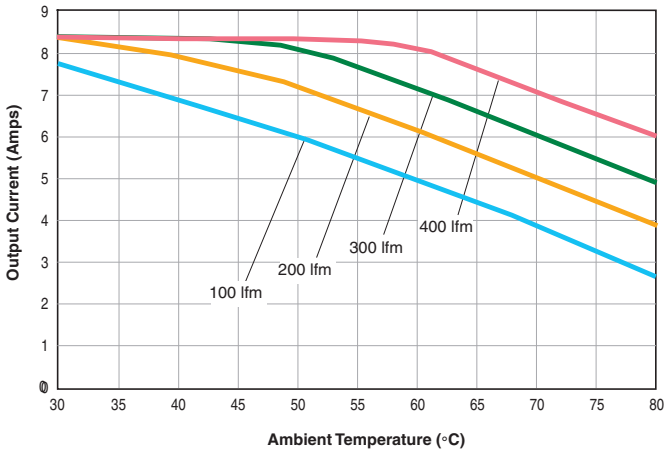


Typical Performance Curves

UCQ-12/8.3-D48 Efficiency vs Line Voltage and Load Current @25° C



UCQ-12/8.3-D48 Maximum Current Temperature Derating
No baseplate, V_{IN} = 48V (at sea level), longitudinal airflow



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06/09/08

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